Effects of a 10-week High-Intensity Exercise Intervention on College Staff with Psychological Burnout and Multiple Risk Factors

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Abstract

This study examined the effect of a 10-week physical exercise program on the health status of college staff. Eighty-one participants were pre-tested on 22 variables including physical fitness, biochemical status, psychological health, and morphological measures. Participants in an experimental group ($n = 61$) received a 10-week intervention consisting of aerobic activities and weight training whereas the remainder ($n = 20$) constituted a control group. The intervention program was monitored and controlled using the Cooper points system so that the exercise intensity increased gradually and the exercise session duration decreased across the ten weeks. The posttest results indicated that the experimental group had significant improvement on most of the 22 variables, but there was no improvement in any variable within the control group. In addition, those with more than three coronary artery disease risk factors, emotional exhaustion, or high waist-hip ratio in the experimental group improved in most of the variables as well. Finally, the findings demonstrated significant correlations between change in training intensity and change in selected variables for those with both emotional exhaustion and more than three risk factors of coronary artery disease in the experimental group.

Key words: multiple risk factors, job stress

Introduction

Staff at academic institutions work in an increasingly demanding environment as the academic sector has undergone large-scale organizational restructuring, downsizing and government funding cuts in recent years (Gillespie, Walsh, Winefields, Dua & Souch, 2001; Otero-López, Mariňo, & Bolaňo, 2008). Various studies have reported psychological distress, low job satisfaction, high levels of job stress and job insecurity among staff at tertiary institutions (Gillespie et al.; Lacy & Sheehan, 1997; Tytherleigh, Webb, Cooper, & Ricketts, 2005; Winefield & Jarrett, 2001). Psychological distress as a precursor of cardiac risk, cardiovascular disease and cardiovascular reactivity has recently received much attention, and the general conclusion is that psychological distress is a health and social issue of utmost importance.

Stress only becomes a health hazard when coping resources have been depleted, which means a person could report high levels of stress without necessarily presenting with poor health. Current theory is that chronic stress leads to a higher allostatic load or elevated coronary risk factors such as blood pressure, waist/hip ratio, percentage body fat, total cholesterol/ high density lipoprotein ratio, and glucose intolerance. These risk factors keep on spiralling into increasingly worse physical and psych-emotional health (Krantz & McCeney, 2002; Melamed, Shirom, Toker, Beliner, & Shapira, 2006).

In essence chronic stress seems to cause a clustering of risk factors, and the risk associated with any particular risk factor varies widely depending on the amount of clustering. Individuals with multiple marginal abnormalities or borderline risk factors — who are often at greater risk than people with one or two major risk factors — are easily overlooked for aggressive treatment with a categorical risk factor count approach. Cost-effective targeting of individuals with cardiovascular diseases for aggressive control of their risk therefore requires multivariable risk assessment. This tendency of risk factors to cluster has also been attributed to insulin resistance (or metabolic syndrome) and its associated precursor abdominal obesity (Kannel, D'Agostino, Sullivan, & Wilson, 2004).

Psychological distress has been linked to both abdominal obesity and insulin resistance but has as yet not been thoroughly explored for its cluster-causing effect (Melamed et al., 2006). Psychological distress in association with abdominal obesity and multiple arteriosclerotic disease risk factors may present a lethal combination and it is important to determine how such individuals will respond to a conservative non-drug treatment modality such as physical activity. Equally important is the need to identify cost-effective aggressive treatment modalities that could lower the potential risk of people with multiple risk factors.

Little information is available on the relationship between the psychological health, fitness and cardiac risk profiles of academic staff, and very few attempts have been made to study the effect of physical exercise intervention on the pathological process accounting for the clustering of risk factors. Further, there is a scarcity of information in particular about the intricate relationship — and the effect of exercise training on it — between psychological health, certain morphological variables such as abdominal obesity, and markers of physiological distress and coronary risk. In addition, the relative importance of training intensity is another area that presents with conflicting information in the scientific literature. The optimal intensity and amount of exercise necessary for reduction in risk or risk factors is largely unknown and differs from one risk factor to another. Depending on the study design and risk factors investigated some studies/researchers concluded that training volume is more important than training intensity (Kraus et al., 2002), whereas others suggest that it is all about training at an intensity high enough to increase cardiovascular fitness levels (Fogelholm, 2010; Nagano, Sasaki, & Kumagai, 2005).

Romijn et al. (1993) and Wolfe (1998) have found that only during high intensity exercise are triglycerides hydrolysed within the muscle to release fatty acids for direct oxidation. In addition, Ebisu (1985) reported increases in high density lipoprotein-cholesterol as a result of intermittent high intensity exercise, but not as a result of continuous exercise. The amount of muscle mass involved with exercise also seems to be important with regard to glycogen metabolism according to Steensberg et al. (2002). Nagano et al. (2005) found that the association of psychological distress with hyperinsulinemia and metabolic syndrome hinged on the level of cardiovascular fitness. This might indicate a need for high-intensity exercise programs -if the aim is to lower the typical biochemical cardiac risk factors with physical exercise- in the presence of cluster causing factors such as psychological distress and abdominal obesity.

This study was intended to determine whether a physical exercise program would improve the physical, morphological, psychological and blood lipid profiles of a mix gender group consisting of staff members at a higher educational teaching institution. The effect of exercise on the above mentioned variables has been well proven in experimental studies using mostly males and longer intervention periods (4 months and longer) often in combination with diet intervention strategies (Blair & Oberman, 1987; Byrne, 1991; Wood & Stefanick, 1990). Whether the typical physical, morphological, psychological and blood lipid risk factors could be reduced within 10 weeks with high-intensity physical exercise without diet intervention in a mix gender group in worksite fitness programs put a different perspective on this issue.

Specifically, this study was to (a) examine the effect of high-intensity intermittent and whole body exercises on the physical, morphological, psychological and blood lipid profiles of a free-living mix gender group consisting of staff members at a higher educational teaching institution; and (b) examine the effect of exercise training on physiological, morphological, psychological and blood biochemistry profiles of individuals with multiple coronary artery disease (CAD) risk factors, emotional exhaustion (burnout), or elevated hip/waist ratios. Accordingly, two hypotheses were associated with the study. First, a 10-week high-intensity exercise program would improve the physical, psychological, morphological and blood lipid profiles of staff participating in the program. Secondly, the 10-week exercise program would improve the physiological, morphological, psychological and blood biochemistry profiles of individuals with multiple CAD risk factors, emotional exhaustion (burnout), or elevated hip/waist ratios.

Method

Subjects and Grouping

Following ethics approval (Central Regional Ethics Committee, New Zealand) the project was advertised on the website of a college in New Zealand. A request was made for volunteers to join a health promotion and fitness training program run by the Department of Exercise and Sport Science. Eighty-one (56 females) staff members at the college were randomly selected as participants from a total of 150 volunteers indicating their interest in participating in this study. The number of participants was determined by study budget (blood testing cost), equipment (e.g., amount of cycle ergometers), and logistical constrains (availability of testing labs, etc.). Of the 81 subjects, 61 were randomly assigned to an experimental group receiving exercise intervention and the remaining 20 participants were in a control group receiving no intervention. The number of subjects in the experimental group was determined by available exercise trainers, who were practicum students in the college majoring in exercise and sports science. The mean age of the sample was 42.1 years (the experimental group 42.6 years and the control group 41.9 years). Participants in both groups were instructed to maintain their normal eating.

Procedures and Data Collection

The exercise intervention lasted ten weeks. During the week immediately before the start of the intervention, baseline assessments were conducted for all participants. The post-intervention testing was done in the week immediately after the exercise intervention was terminated (week 11). Care was taken to ensure that participants did not do the fitness test on the same day they were scheduled for blood tests and that they did no exercise on days prior to the fitness tests.

Coronary risk was assessed using a coronary risk index reflecting 14 most common or typical risk factors for CAD, and these 14 risk factors were age, family history, body weight, exercise, tobacco smoking, total cholesterol, systolic blood pressure (SBP), diastolic blood pressure (DBP), gender, perceived stress, cardiovascular disease symptoms, personal history of cardiovascular disease, diabetes mellitus, and gout (Bjurstrom & Alexiou, 1978).

Psychological health. Three aspects of psychological health (general life stress, job stress, and emotional exhaustion) were assessed. The general life stress was measured with Perceived Stress Scale (PSS) and its internal reliability ranged from .84 to .86 for a variety of populations (Cohen, Kamarck, & Mermelstein, 1983). The job stress was determined by a questionnaire designed by Dua (1994) specifically measuring job stress in the academic environment. According to Dua, the job stress questionnaire correlated significantly (r = .90 or higher) with job satisfaction and other indicators of work related stress, work condition anxiety, and psychological distress. The emotional exhaustion was measured using the Psychological Burnout Questionnaire (PBQ, Pines, Aronson, & Kafry, 1981) and Happiness, Well-being and Quality of Life questionnaire developed by Kammann and Flett (1983) called the Affectometer 2. The PBQ had internal reliabilities ranging from 0.91-0.93 (Pines et al.). The Affectometer 2 correlated highly (r = -.84) with the Beck Depression Inventory, a validated instrument to assess emotional exhaustion (Kammann & Flett). An internal consistency coefficient of .95 was reported for the Affectometer 2, and the estimated test-retest reliability was .80 for a 2-week period and .53 for over an eight-month period (Kammann & Flett).

Biochemical measures. Total cholesterol (TC), low density lipoprotein-cholesterol (LDL-C), high density lipoprotein-cholesterol (HDL-C), triglycerides, glucose and the total cholesterol/HDL-ratio (TC/HDL-ratio) were assessed using a registered biochemistry laboratory.

Physiological variables. The physiological variables included resting heart rate and resting blood pressure. The resting blood pressure was measured three times after subjects were in the supine position in a quiet room for five minutes, and the lowest reading was recorded. The resting heart rate was measured for a full minute with a stopwatch after the blood pressure was done. In addition, pulse pressure, mean arterial pressure, and systolic blood pressure response/work intensity score during the cycle ergometer test were mathematically calculated.

Morphological measures. Height was measured with shoes removed on a stadiometer, weight was recorded with the shoes and as much other clothes removed as possible, and body mass index (BMI) was calculated based on height and weight data. Waist circumference was taken at the smallest waist circumference above the umbilicus or navel and below the xiphoid process, hip circumference was taken at the largest circumference around the buttocks and above the gluteal fold, and waist-to-hip ratio (WHR) was calculated accordingly. Percent body fat was obtained using the six skinfold procedure (triceps, subscapula, supra-iliac, abdominal, thigh and medial calf) according to the guidelines of the International Society for the Advancement of Kinanthropometry (2001). Percent body fat was calculated using a six-site formula for males [(sum of skinfolds) × 0.1051+ 2.588] and another six-site formula for females [(sum of skinfolds) × 0.1548 + 3.58] (American College of Sport Medicine [ACSM], 2005).

F**unctional capacity.** Baseline physiological assessments of aerobic fitness were made using the YMCA cycle ergometer sub-maximal test protocol (ACSM, 2010). The testing protocol comprised a 3-minute warm-up at 25 Watts followed by 3-minute stages with increments in power output, depending on the subject's heart rate and blood pressure exercise response. The aim was to push each individual to at least 70% of his/her age adjusted maximum heart rate but blood pressure responses were used to determine symptom maximums on the odd occasion when blood pressure responded poorly (systolic raising above 230 mmHg or diastolic increasing by more than 10 mmHg) during the exercise test. Heart rate was manually recorded every minute of each stage with a heart rate monitor, while exercise blood pressure was manually recorded during the last minute of each stage. Karvonen's formula (ACSM, 2010) was used to determine 80% of maximum heart rate (220 — age — RHR × training percentage + RHR). The ACSM's (2010) guidelines were used for early termination of the test. The ACSM metabolic and multistage equations (2010) were utilized to calculate each individual's relative predicted VO_{2max} and/or functional capacity in Mets (VO_{2max} divided by 3.5).

Exercise Intervention

Following the baseline assessments, the experimental group received a 10-week exercise intervention consisting of a combination of (a) aerobic exercise (cycling, stair climber, treadmill running) and (b) resistance exercise (weight training). The exercise intervention was designed by the research team and conducted under the supervision of it. Two clients (participants in the experimental groups) were assigned to a college student majoring in exercise and sports science, who were responsible for implementing the exercise intervention for the assigned clients. Clients participated in the intervention four to five days per week alternating between the aerobic exercise and the weight training every other day.

For the aerobic exercise session, the Cooper point system (Cooper, 1985) was used to calculate Cooper points the clients obtained in the aerobic sessions. Changes in frequency, duration, or intensity would result in corresponding changes in the Cooper point, which reflected the amount of exercise. Aerobic exercise sessions were designed in a way that clients would accumulate their Cooper points by increasing exercise intensity and decreasing exercise duration across the ten weeks. That is, clients started training at 40—50% of age-adjusted maximum heart rate with 40-minute sessions for the first two weeks, followed by 50 to 60% of age-adjusted maximum heart rate with 30-minute sessions during the next three weeks, and 70% or higher with 20-minute sessions for the last four weeks.

With respect to the weight training session, it consisted of 4-5 sets of four exercises with a 30-second recovery interval between sets. Clients would rotate through each set of four exercises twice doing 15 to 20 repetitions of each exercise before moving to the next set. The entire circuit had to be completed within 40 minutes with clients reaching or getting close to target heart rates by the end of the second set, and then maintaining the heart rate for the rest of the session. Circuit training intensities were adjusted over the 10 weeks by either increasing the training loads or replacing easier exercises with more challenging ones.

During both aerobic sessions and weight training sessions, heart rates were constantly monitored with a polar heart rate monitor and clients were challenged to maintain the target heart rates. Clients were also challenged from the first week to accumulate 30 Cooper points per week.

Data Analysis

Paired samples t tests were used to assess pre- and post-intervention statistical differences in the experimental and control groups with regard to the morphological, physiological, biochemical and psychological variables measured. Correlations were used to relate the magnitude of change in the VO_{2peak}, and intensity of training (Cooper points averaged during the 10-weeks training program) with the extent of change in biochemical, morphological and psychological variables. In order to maintain enough respondents and to ensure adequate statistical power sexes were mixed in data analysis.

Pre- and post-intervention data were compared using paired samples t tests for three groups of at-risk individuals in the experimental group: (a) those with more than three CAD risk factors, (b) those with emotional exhaustion, and (c) those with a high waist-hip ratio. Cut-offs for the multiple CAD risk factor group were based on ACSM (2010) guidelines and they were resting systolic blood pressure, >140 mmHg; resting diastolic blood pressure, > 90 mmHg; functional capacity, < 8.0 METs; physically inactive, < three time a week (20-30 minutes/time) ; total cholesterol, > 6.3 $mmol.l^{-1}$; triglycerides, > 2.3 $mmol.l^{-1}$; Glucose, > 6.0 $mmol.l^{-1}$; HDL-cholesterol, < 1.0 $mmol.l^{-1}$; LDL-cholesterol, > 4.2 $mmol.l^{-1}$; and TC/HDL ratio, > 4.6.

The cut-offs for the psychological constructs are based on the guidelines provided by the articles in which these measuring tools were found. They were, Negative effect < 24 (Kammann & Flett, 1983); emotional exhaustion, burnout scores > 4.0 (Pines et al., 1981); stress symptoms, >15; (Dua, 1994), and job stress, >1.67 (Cohen et al., 1983). The cut-offs for body composition measures were percentage body fat, male > 16% and female > 26%; obesity, BMI > 30.0; and waist-hip ratio, male > 0.94 and female > 0.82 according to ASCM (2005, 2010) guidelines.

Results

Descriptive statistics and t test results of pre-and post-intervention data for both groups are presented in Table 1. The 10-week exercise intervention had a significant ($p \leq 0.05$) positive effect on the experimental group. With respect to the physiological and morphological variables, all the variables except for diastolic blood pressure and waist/hip-ratio were significantly improved. Also, all the psychological variables had a significant improvement. Finally, five biochemistry variables (total cholesterol, HDL-cholesterol, LDL-cholesterol, TC/HDL-ratio and the Coronary risk index) out of the seven were improved significantly. In a striking contrast, none of the variables in the control group were significantly improved during the ten weeks.

Table 1. ***Comparison of Pretest and Posttest in Dependent Variables for the Experimental and Control Groups***

Variable	Experimental			Control		
	Pretest	Posttest	*p*	Pretest	Posttest	*p*
Physiological Variables						
Resting heart rate	72.0 ±12.7	66.8 ± 6.7	< .01	69.7 ± 12.8	70.2 ± 8.1	.76
Systolic blood pressure	128.6 ±11.7	122 ±10.9	<.01	126.7 ±9.9	126 ±10.9	.58
Diastolic blood pressure	78.3 ±8.4	76.6 ±7.9	.07	80.1 ±10.8	81.5 ±7.4	.33
Pulse pressure	50.3 ±11.7	46.1 ± 8.8	<.01	45.9 ±6.9	45.3 ±6.9	.72
Mean arterial pressure	95.1 ±7.9	91.9 ±8.0	<.01	95.4 ±9.9	96.5 ±8.1	.29
$VO_{2\ peak}$	30.9 ±6.9	35.4 ±9.2	<.01	32.4 ±8.6	32.8 ±7.6	.46
SBP[a]/work intensity score	10.4 ±5.6	8.5 ± 4.4	<.01	10.9 ±6.9	10.4 ±6.8	.47
Morphological Variables						
Percentage body fat	21.5 ±8.7	19.6 ±8.1	<.01	18.9 ±5.9	19.5 ±6.4	.30
Body weight (kg)	79.8 ±17.5	78.8 ±16.6	<.01	70.1 ±11.6	70.2 ±12.4	.59
Waist-hip ratio	0.83 ±0.08	0.82 ±0.08	.12	0.76 ±0.08	0.77 ±0.08	.17
Waist circumference (cm)	88.1 ±13.3	85.9 ±11.7	<.01	77.6 ±11.3	78.2 ±10.7	.22
Psychological Variables						
Stress symptoms	12.2 ±6.9	10.2 ±6.9	<.01	13.9 ±10.0	13.4 ± 9.8	.73
Job stress	1.53 ±0.26	1.47 ±0.23	<.01	1.65 ±0.32	1.59 ±0.32	.14
Emotional burnout	2.99 ±0.63	2.69 ±0.71	<.01	2.82 ±0.98	2.79 ±0.99	.77
Positive/negative affect	20.69 ±10.9	24.8 ±10.0	<.01	23.9 ±1.6	23.2 ±13.4	.56
Biochemistry Variable						
Total cholesterol	5.17 ±0.97	4.98 ±0.83	.04	5.58 ±0.95	5.49 ±0.82	.41
Fasting glucose	4.75 ±0.85	4.61 ±0.66	.12	4.63 ±0.37	4.52 ± .95	.13
Triglycerides	1.34 ±0.65	1.46 ±0.88	.07	1.43 ±0.72	1.48 ±0.82	.26
HDL cholesterol[b]	1.64 ±0.45	1.76 ±0.47	<.01	1.68 ±0.38	1.71 ±0.49	.12
LDL cholesterol[c]	2.92 ±0.88	2.59 ±0.73	<.01	2.87 ±0.74	2.76 ±0.68	.19
TC/HDL ratio[d]	3.15 ±1.06	2.82 ±0.87	<.01	3.32 ±0.74	3.19 ±0.75	.09
Coronary risk index	25.15 ±6.61	22.4 ±7.46	.03	21.1 ±7.13	21.9 ±7.29	.73

[a]Systolic blood pressure. [b]High density lipoprotein cholesterol. [c]Low density lipoprotein cholesterol. [d]Total cholesterol/high density lipoprotein cholesterol ratio.

The effect of the exercise intervention on the at-risk individuals in the experimental group is presented in Table 2. Most variables demonstrated significant improvement among the at-risk individuals after the 10-week exercise intervention. Only four variables (DBP, stress symptoms, glucose and triglycerides) showed no improvement across the three at-risk groups, and several variables (pulse pressure, job stress, positive/negative affect, HDL-C, LDL-C, body weight, and waist-hip ratio) did not indicate the significant improvement in one of the three at-risk groups. In addition (not included in Table 2), the percentage of individuals in the experimental group with three or more CAD risk factors was reduced from 29.4% to 11.5% during the intervention period.

The impact of training intensity on health promotion was assessed by correlating the amount of change in $VO_{2\text{-peak}}$ with the amount of change in selected variable, which were logically related to training intensity or demonstrated significant improvement during

Table 2. ***Comparison of Pretest and Posttest in Dependent Variables for Those with Emotional Exhaustion, High Waist-Hip Ratio, or Multiple Coronary Artery Disease Risks in the Experimental Group***

	Individuals with Emotional Exhaustion			Individuals with High Waist-Hip Ratio			Individuals with Multiple CAD[a] Risks		
Variable	Pretest	Posttest	*p*	Pretest	Posttest	*p*	Pretest	Posttest	*p*
Physiological Variable									
Resting heart rate	72.9 ±13.6	66.6 ±10.0	<.01	75.4 ±12.1	65.8 ±10.1	<.01	76.3 ±13.97	0.7 ±10.7	.015
Systolic blood pressure	129.8 ±9.5	123.9 ±9.8	<.01	129.9 ±10.1	124.8 ±10.1	<.01	134.2 ±11.1	27.0 ±11.7	<.01
Diastolic blood pressure	79.4 ±9.9	77.6 ±8.6	.29	80.9 ±8.3	78.2 ±7.2	.09	80.6 ±8.9	9.3 ±8.0	.41
Pulse pressure	50.5 ±9.7	46.3 ±8.4	.02	48.9 ±9.9	46.7 ±8.5	.12	53.6 ±12.5	47.8 ±8.2	.014
Mean arterial pressure	96.2 ±8.7	93.1 ±8.1	.02	97.3 ±7.6	93.8 ±7.2	<.01	98.4 ± 7.7	95.2 ±8.6	<.01
VO_{2peak}	32.3 ±7.2	36.3 ±9.8	<.01	28.3 ±7.82	31.4 ±9.0	<.01	27.2 ± 5.8	31.7 ±8.0	<.01
SBP[b]/work intensity score	10.1 ±3.0	8.18 ±2.8	.01	13.0 ±7.3	10.5 ±6.0	<.01	11.9± 6.9	9.1 ±5.7	<.01
Morphological Variable									
Percentage body fat	20.3 ±7.95	18.2 ±7.99	<.01	25.5 ±8.77	23.2 ±7.65	.01	25.7 ± 9.1	23.4 ±8.9	<.01
Body weight (kg)	79.5 ±15.6	78.7 ±14.5	.08	83.2 ±18.9	82.1 ±17.9	.02	92.2 ±15.7	90.1 ±14.7	<.01
Waist-hip ratio	0.84 ±0.09	0.83 ±0.09	.02	0.89 ±0.07	0.87 ±0.06	.01	0.84 ±0.08	0.84 ±0.08	.86
Waist circumference (cm)	87.4 ±11.7	85.6 ±10.8	<.01	95.8 ±13.6	92.4 ±10.6	<.01	96.8 ±12.5	93.9 ±9.63	<.01
Psychological Variable									
Stress symptoms	15.5 ±7.6	13.2 ±8.2	.07	12.1 ±8.1	11.4 ±6.9	.49	12.3 ± 7.4	10.9 ±8.0	.21
Job stress	1.68 ±0.24	1.57 ±0.24	.03	1.50 ±0.26	1.42 ±0.22	.02	1.52 ±0.24	1.49 ±0.25	.27
Emotional exhaustion	3.63 ±0.55	3.25 ±0.74	<.01	2.97 ±0.68	2.87 ±0.86	.27	3.06 ±0.60	2.75 ±0.63	<.01
Positive/Negative Affect	11.6 ±11.9	17.8 ±10.3	<.01	19.9 ±10.4	22.3 ±11.4	.04	20.6 ±12.1	22.8 ±11.1	.18
Biochemistry Variable									
Total cholesterol	5.13 ±0.8	4.98 ±0.84	.32	5.02 ±0.8	4.86 ±0.75	.12	5.39 ±0.87	5.00 ±0.94	<.01
Glucose	4.89 ±0.98	4.55 ±0.38	.09	4.94 ±1.01	4.89 ±0.94	.63	5.04 ±1.01	4.81 ±0.82	.19
HDL cholesterol[c]	1.56 ±0.39	1.69 ±0.42	<.01	1.45 ±0.30	1.53 ±0.33	.06	1.53 ±0.40	1.65 ±0.41	<.01
LDL cholesterol[d]	2.96 ±0.74	2.64 ±0.76	.03	2.89 ±0.74	2.64 ±0.72	.07	3.18 ±0.89	2.59 ±0.79	<.01
TC/HDL-ratio[e]	3.49 ±0.99	3.10 ±0.89	<.01	3.64 ±1.07	3.33 ±1.02	<.01	3.78 ±1.27	3.19 ±1.08	<.01
Triglycerides	1.35 ±0.69	1.42 ±0.75	.47	1.51±0.76	1.72 ±1.29	.24	1.52 ±0.79	1.68 ±1.21	.37
Coronary risk index	26.1 ±6.78	23.2 ± 7.43	<.01	26.5 ±7.55	23.5 ±7.81	<.01	29.4 ±5.87	26.3 ±8.71	<.01

Note. Some individuals were in more than one at-risk group.
[a]Coronary artery disease. [b]Systolic blood pressure. [c]High density lipoprotein cholesterol. [d]Low density lipoprotein cholesterol. [e]Total cholesterol/high density lipoprotein cholesterol ratio.

the 10-week intervention. These comparisons were made for those in the experimental group who had both emotional exhaustion and more than three CAD risk factors (n = 10). The intensity of training that was indicated by the Cooper points correlated statistically significant with the percentage change in the majority of the selected variables (Table 3). In addition, the Cooper points were also correlated significantly with the percentage change in VO_{2peak}, sharing 42% (.652 = .422) of their variance, indicating that improvement in VO_{2peak} was highly related to intensity of training.

Discussion

The results strongly support the research hypotheses of this study. The 10-week exercise program improved the physiological, morphological, psychological and blood biochemistry profiles of staff at a higher educational teaching institution. That is, the experimental group improved significantly in most variables. In addition, the training program improved health conditions for participants with more than three CAD risk factors, high emotional exhaustion, or high waist-hip ratio.

The results of the present study indicate that an exercise program

Table 3. ***Correlations between Change in Training Intensity and Change in Selected Variables for Those with Both Emotional Exhaustion and More than Three Risk Factors of Coronary Artery Disease in the Experimental Group (n = 10)***

	VO_{2peak} Change	Cooper Points over 10 Weeks
Cooper points over 10 weeks	0.65*	1.00
SBP[a] change	0.23	0.42*
Percentage body fat change	0.01	0.10
Emotional burnout change	0.38*	0.28
Positive/negative affect change	0.24	0.27
Stress symptoms change	0.34	0.48*
Job stress change	0.41*	0.33
Total cholesterol change	0.42*	0.41*
LDL[b] cholesterol change	0.43*	0.44*
HDL[c] cholesterol change	0.48*	0.50*
TC/HDL[d] ratio change	0.46*	0.49*
Glucose change	0.62*	0.94*
Triglyceride change	0.41*	0.42*
SBP/work intensity score	0.75*	0.58*

[a]Systolic blood pressure. [b]Low density lipoprotein. [c]High density lipoprotein. [d]Total cholesterol/high density lipoprotein.
*$p < .05$.

can impact positively on the health and well-being of a workforce in a real life situation where the respondents could keep with their daily work routines. It is therefore appropriate to suggest that this type of health intervention may yield positive results in areas such as staff turnover, absenteeism, and productivity in the workforce, which was found in other studies (e.g., Edington, Yen, & Whiting, 1997).

The findings also suggest that the results obtained had much to do with the intensity of the training sessions. Change in cardiovascular fitness (VO_{2peak}) and intensity of training (Cooper points) shared 42% of their respective variances, indicating they are strongly related. Both variables also correlated significantly with the amount of change obtained in most of the selected variables.

Comprehensive reviews suggest that exercise has little effect on total cholesterol or low-density lipoprotein cholesterol (LDL) concentrations (Durstine & Haskell, 1994; Leon & Sanchez, 2001) and only a minimal and inconsistent beneficial effect on high-density lipoprotein (HDL) cholesterol concentrations (Leon & Sanchez). However, there seems to be two main deficiencies in the current knowledge in this area. First, there is a lack of prospective, randomized exercise studies comparing different types, amounts, and intensities of exercise. Second, the impact of multiple CAD risk factors and/or cluster causing factors like abdominal obesity and psychological distress on the exercise lipid relation has not been well studied. A particular strength of the present study is that we utilized training protocols (high intensity exercise and whole body circuit training), which were not commonly used in studies exploring the impact of physical exercise on blood lipids. The measures implemented in the present study to monitor and ensure high intensity training are relatively unique and in all probability key to the positive results obtained. Clients were closely supervised during the intervention, and exercise programs were specifically designed to enforce increased training intensity over time.

Neither the 10-week training period utilized in this study nor the positive results on the risk profiles of respondents are out of sync with procedures and findings of other studies on the topic. Leon, Casal, and Jacobs (1996) used a 12-week intervention consisting of moderate pace continuous walking and stair climbing equal to an energy cost of 2000 kcal per week for 22 healthy, slightly overweight, sedentary, normotensive, and normolipemic men. Kim, Oberman, Fletcher, and Lee (2001) compared the impact of twice a week low (55%) and high (85%) intensity continuous walking on the lipid profiles of 185 CAD patients. Both studies indicated that exercise intensity had little effect on results.

High intensity intermittent interval training in contrast coincide in scientific studies with marked improvements in lipid profiles, cardiovascular fitness and skeletal muscle oxidative capacity within relatively short training periods. Gibala and McGee (2008) induced improvements on skeletal muscle oxidative capacity and endurance performance with just six high intensity intermittent training sessions within 14 days. Cardiovascular adaptations in patients with CAD (Rogmo, Hetland, Helgerud, Hoff, & Slordahl, 2004), chronic heart failure (Hambrecht et al., 2000), and left ventricular dysfunction (Warburton et al., 2005) were also induced with intermittent high intensity exercise.

The present study had some limitations. First, sexes were combined in the study, which could confuse the exercise effect obtained for certain variables. In addition, the size of the control group was much smaller than that of the experimental group when two groups were compared in terms of intervention results, and there was no control group involved when examining intervention results for participants with multiple CAD risk factors, emotional exhaustion, or abdominal obesity. Finally, the intervention involved physical activity only, but not diet, which is another important factor impacting health. Future studies addressing these limitations are needed.

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